(51) International Patent Classification 4 : G01F 1/30, 1/76

A1

(43) International Publication Date : 10 November 1988 (10.11.88)

(21) International Application Number : PCT/EP88/00490

(22) International Filing Date : 3 May 1988 (03.05.88)

(31) Priority data :
88/3122 3 May 1988 (03.05.88) ZA

Published
With international search report
With amended claims and statement

WO 88/08082

AE

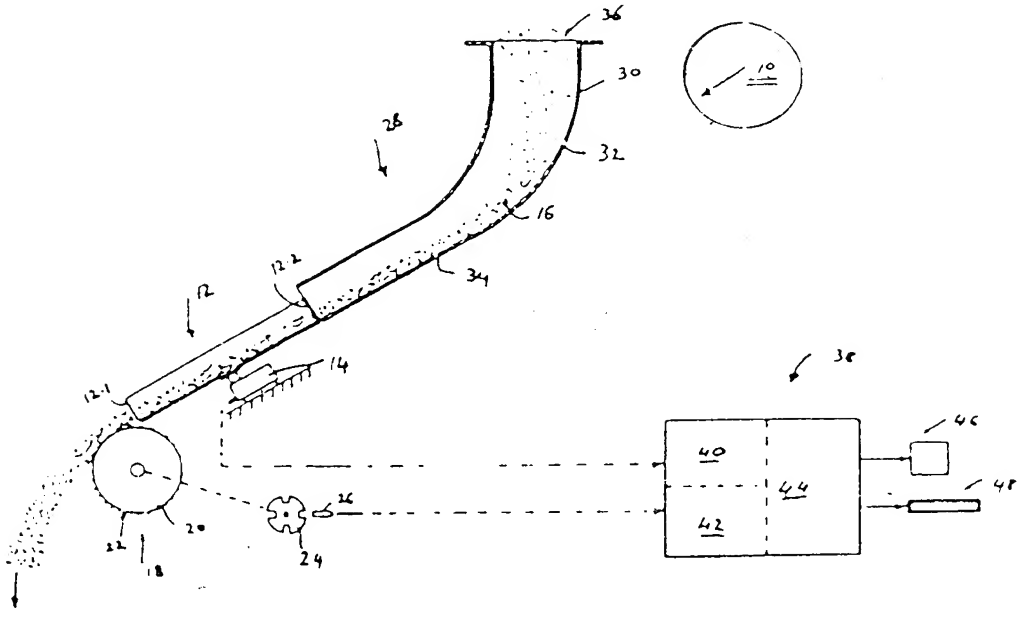
BEST AVAILABLE COPY

(72) Applicant and Inventor : NEL MULLER, Josef [AT/ZA]; 3 Highgate Lane, Bryanston, 2000 Johannesburg (ZA).

(74) Agents : LEIN, Werner et al. ; Arabellastrasse 4, D-8000 Munich 81 (DE).

(81) Designated States : AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), SU, US

(54) Title : METHOD OF AND APPARATUS FOR WEIGHING A CONTINUOUS STREAM OF FLUENT MATERIAL



(57) Abstract

A method of and an apparatus for weighing a continuous stream of fluent material (16) includes a weighing means (12) which, in use, in the direction of flow of the material, is arranged in a plane which is at an acute angle relative to a vertical plane, and measuring means (14) for measuring the load imparted by the material (16) to the weighing means (12), the load measuring means (14) being arranged at substantially the same angle as the weighing means (12) to neutralise the effect of any frictional forces generated between the material (16) and the weighing means (12), and the load measuring means (14) being operable to generate a first signal representative of mass of the material; a speed measuring means (18) for measuring the speed of flow of the material (16) and for generating a second signal which is representative of the speed of flow of the material; and a processing means (38) for processing the first signal and the second signal to obtain an output signal which is representative of mass flow of the material

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	ML	Mali
AU	Australia	FR	France	MR	Mauritania
BB	Barbados	GA	Gabon	MW	Malawi
BE	Belgium	GB	United Kingdom	NL	Netherlands
BF	Burkina Fasso	HU	Hungary	NO	Norway
BG	Bulgaria	IT	Italy	RO	Romania
BJ	Benin	JP	Japan	SD	Sudan
BR	Brazil	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic			SN	Senegal
CG	Congo	KR	Republic of Korea	SU	Soviet Union
CH	Switzerland	LI	Liechtenstein	TD	Chad
CM	Cameroon	LK	Sri Lanka	TG	Togo
DE	Germany, Federal Republic of	LU	Luxembourg	US	United States of America
DK	Denmark	MC	Monaco		
ES	Spain	MG	Madagascar		

Method of and apparatus for weighing a continuous stream of fluent material

Description:

This invention relates to the weighing of material. More particularly, the invention relates to a method of, and apparatus for, weighing a continuous stream of fluent material.

According to a first aspect of the invention, there is provided a method of weighing a continuous stream of fluent material which includes

directing the material onto a weighing means which, in the direction of flow of the material is arranged in a plane at an acute angle relative to a vertical plane;

measuring, in a plane substantially parallel to the plane in which the weighing means is arranged, the load applied by the material to the weighing means and generating a first signal representative of mass of the material;

measuring the speed of flow of the material and generating a second signal representative of the speed of flow of the material; and

processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

The weighing means may comprise a weigh chute and the method may then include feeding the material into the

weigh chute by means of a feed means, at least that portion of the feed means arranged adjacent the weigh chute being arranged at substantially the same angle as the weigh chute and being co-axially aligned with the weigh chute. Those skilled in the art will appreciate that, by arranging the said portion of the feed means at the same angle as the weigh chute, the material arriving in the feed means is stabilised in the feed means and then traverses the weigh chute at a substantially constant speed.

Further, those skilled in the art will appreciate that, by measuring the load applied by the material to the weigh chute in a plane substantially parallel to the plane in which the weigh chute is arranged, the effect of any frictional forces generated between the material and the weighing means is neutralised and it is not necessary to compensate for such frictional forces.

According to a second aspect of the invention, there is provided apparatus for weighing a continuous stream of fluent material which includes

a weighing means which, in use, in the direction of flow of the material, is arranged in a plane which is at an acute angle relative to a vertical plane;

a load measuring means for measuring the load imparted by the material to the weighing means, the load measuring means being arranged at substantially the same angle as the weighing means to neutralise the effect of any frictional forces generated between the material and the weighing means, and the load measuring means being

operable to generate a first signal representative of mass of the material;

a speed measuring means for measuring the speed of flow of the material and for generating a second signal which is representative of the speed of flow of the material; and

a processing means for processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

The weighing means may comprise a weigh chute through which the material can pass.

The apparatus may include a feed means for feeding the material into the weigh chute, at least that portion of the feed means arranged adjacent an inlet end of the feed means being at substantially the same angle as the weigh chute. The feed means may comprise a feed chute. The said portion of the feed means and the weigh chute may be similarly dimensioned and shaped. Further, the feed means and the weigh chute may be of a material having a low co-efficient of friction. Thus, conveniently, the feed means and the weigh chute may be of polished stainless steel.

The load measuring means may comprise a load transducer which supports the weigh chute.

The speed measuring means may comprise a speed measuring wheel having a ribbed surface on which the material impinges to rotate the wheel, the wheel being

arranged at an outlet end of the weigh chute and the speed measuring means may further include a monitoring means for monitoring the speed of rotation of the wheel, the monitoring means generating the said second signal.

The invention is now described by way of example with reference to the accompanying diagrammatic drawing which shows a schematic sectional side view of apparatus, in accordance with the invention, for weighing a continuous stream of fluent material.

Referring to the drawing, apparatus, in accordance with the invention, for weighing a continuous stream of fluent material, is illustrated and is designated generally by the reference numeral 10.

The apparatus 10 comprises a weighing means in the form of a weigh chute 12 which is arranged in a plane which is at an acute angle relative to a vertical plane. A load measuring means in the form of a load transducer 14 supports the weigh chute 12. The transducer 14 is arranged at substantially the same angle as the weigh chute 12 thereby to neutralise the effect of frictional forces generated between the material 16 flowing through the weigh chute 12 and teh weigh chute 12 itself.

A speed-measuring means 18 is arranged at an outlet end 12.1 of the weigh chute 12. The speed-measuring means comprises a speed measuring wheel 20 having a ribbed surface 22 on which the material 16 can impinge to cause the wheel 20 to rotate.

The wheel 20 is constructed of a relatively light-weight material to ensure low inertia and the wheel 20 is mounted on low-friction bearings to ensure that the running speed of the wheel 20 is proportional to the speed of the stream of material 16 leaving the weigh chute 12. A monitoring means in the form of a slotted disk 24 is fixed to a shaft on which the speed-measuring wheel 20 is mounted and the disk 24 rotates together with the wheel 20. The slotted disk 24 is operable to activate a proximity switch 26 which generates a signal comprising a pulse train representative of the speed of the stream of the material 16.

The apparatus 10 further inclused a feed means 28 for feeding the material 16 into an inlet end 12.2 of the weigh chute 12. The feed means 28 comprises a feed chute 30 having a curved portion 32 leading into a substantially rectilinear portion 34. The rectilinear portion 34 is arranged at substantially the same angle as the weigh chute 12 and the load transducer 14. The shape of the feed chute 30 ensures that the material 16 arriving in the feed chute 30 via an inlet opening 36 of the feed chute 30 stabilises in the feed chute 30 and slides into the weigh chute 12 at a constant speed. The feed chute 30 and the weigh chute 12 are made of polished stainless steel to reduce frictional forces generated between the portion 34 of the feed chute 30 and the weigh chute 12 and the material 16 sliding through the chutes 12 and 30.

In use, the material 16 to be weighed is fed into

the feed chute 30 through the inlet opening 36 thereof and due to the shape of the feed chute 30 the speed of the material is stabilised such that, when the material 16 flows into the weigh chute 12 the material is travelling at a substantially constant speed.

The load imparted by the material 16 to the weigh chute 12 is measured by the load transducer 14 and a first signal representative of mass of the material 16 is generated by the load transducer and is fed to a processing means 38. The material 16 exiting the weigh chute 12 impinges on the ribbed surface of the speed measuring wheel 20 causing it to rotate. The rotation of the wheel 20 causes the slotted disk 24 to rotate and this operates the proximity switch 26 to generate a second signal representative of the speed of the material 16. The second signal is also fed to the processing means 38.

The processing means 38 comprises an amplification means 40 for amplifying the signal received from the load transducer 14.

The processing means 38 further comprises a multiplier 42 for multiplying the signal output from the amplifier 40 and the signal received from the proximity switch 26. An output from the multiplier 42 is then filtered and fed to a scaling and pulse conversion module 44. The scaling and pulse conversion module 44 has two outputs which provide an indication of mass flow rate on a meter 46 and totalisation of material weighed on a

display 48. The processing means 38 comprises standard electronic components which will be readily realisable to a person skilled in the art. Hence, the circuitry of the processing means 38 is not described any further.

It is an advantage of the invention that, other than the wheel 20, the apparatus 10 comprises no moving parts and hence the reliability of the apparatus 10 is improved in comparison with other weighing apparatus of which the applicant is aware. Further, due to the orientation of the load transducer 14 relative to the weigh chute 12, it is not necessary to compensate for the effect of frictional forces generated between the materials 16 and the weigh chute 12.

The apparatus 10 in accordance with the invention can be used for any free or semi-free flowing materials and can be built and calibrated according to any capacity requirement.

Claims:

1. A method of weighing a continous stream of fluent material comprising the steps:

directing the material onto a weighing means which, in the direction of flow of the material is arranged in a plane at an acute angle relative to a vertical plane;

measuring, in a plane substantially parallel to the plane in which the weighing means is arranged, the load applied by the material to the weighing means and generating a first signal representative of mass of the material;

measuring the speed of flow of the material and generating a second signal representative of the speed of flow of the material; and

processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

2. The method as claimed in claim 1 in which the weighing means comprises a weigh chute and in which the method includes feeding the material into the weigh chute by means of a feed means, at least that portion of the feed means arranged adjacent the weigh chute being arranged at substantially the same angle as the weigh chute, and being co-axially aligned with the weigh chute.

3. A novel method of weighing a continuous stream of fluent material substantially as described and as illustrated herein with reference to the accompanying diagrammatic drawings.

4. Apparatus for weighing a continous stream of fluent material comprising:

a weighing means which, in use, in the direction of flow of the material, is arranged in a plane which is at an acute angle relative to a vertical plane;

a load measuring means for measuring the load imparted by the material to the weighing means, the load measuring means being arranged at substantially the same angle as the weighing means to neutralise the effect of any frictional forces generated between the material and the weighing means, and the load measuring means being operable to generate a first signal representative of mass of the material;

a speed measuring means for measuring the speed of flow of the material and for generating a second signal which is representative of the speed of flow of the material; and

a processing means for processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

5. The apparatus as claimed in claim 4 in which the weighing means comprises a weigh chute through which the material can pass.

6. The apparatus as claimed in claim 5 which includes a feed means for feeding the material into the weigh chute, at least that portion of the feed means arranged adjacent an inlet end of the feed means being at substantially the same angle as the weigh chute.

7. The apparatus as claimed in claim 4 in which the load measuring means comprises a load transducer which supports the weigh chute.

8. The apparatus as claimed in claim 5 in which the speed measuring means comprises a speed-measuring wheel having a ribbed surface on which the material impinges to rotate the wheel, the wheel being arranged at the lower end of the weigh chute and the speed measuring means further including a monitoring means for monitoring the speed of rotation of the wheel, the monitoring means generating the said second signal.

9. A new apparatus for weighing a continuous stream of fluent material substantially as described and as illustrated herein, with reference to the accompanying diagrammtic drawings.

AMENDED CLAIMS

[received by the International Bureau on 05 October 1989 (05.10.89) original claims 1 and 2 replaced by amended claim 1; claims 3 and 9 cancelled; new claims 2 and 3 added; claims 4-6 replaced by amended claim 4; claims 7 and 8 replaced by amended claims 5 and 6; new claims 7 -10 added (4 pages)]

1. A method of weighing a continous stream of fluent material comprising the steps:

directing the material onto a feed means which, in the direction of flow of the material is arranged in a plane at an acute angle relative to a vertical plane at least at the outlet thereof,

feeding the material into a weigh chute which is completely arranged in a plane at an acute angle relative to a vertical plane, at least the outlet of the feed means geing arranged at substantially the same angle as the weigh chute, and being co-axially aligned with the weigh chute,

measuring, in a plane substantially parallel to the plane in which the weigh chute is arranged, the load applied by the material to the weigh chute and generating a first signal representative of mass of the material;

measuring the speed of flow of the material and generating a second signal representative of the speed of flow of the material; and

processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

2. The method as claimed in claim 1, wherein the load applied by the material to the weigh chute is measured by a load transducer.

3. The method as claimed in claim 1 or 2, comprising the steps:

amplifying the first signal;

multiplying the amplified first signal and the second signal;

filtering, scaling and pulse converting the multiplied signal;

indicating the mass flow rate and the totalisation of material weighed.

4. Apparatus for weighing a continous stream of fluent material (36) comprising:

a feed means (28) which, in use, in the direction of flow of the material, is arranged in a plane which is at an acute angle relative to a vertical plane at least at the outlet thereof;

a weigh chute (12) through which the material can pass, which is completely arranged in a plane at an acute angle relative to a vertical plane, at least the outlet of the feed means (28) being arranged at substantially the same angle as the weigh chute (12), and being co-axially aligned with the weigh chute (12);

a load measuring means (14) for measuring the load imparted by the material to the weigh chute (12), the load measuring means (14) being arranged at substantially the same angle as the weigh chute (12) to

neutralise the effect of any frictional forces generated between the material and the weigh chute (12), and the load measuring means (14) being operable to generate a first signal representative of mass of the material;

a speed measuring means (18) for measuring the speed of flow of the material and for generating a second signal which is represenative of the speed of flow of the material; and

a processing means (38) for processing the first signal and the second signal to obtain an output signal which is representative of mass flow rate of the material.

5. The apparatus as claimed in claim 4, wherein the load measuring means comprises a load transducer (14) which supports the weigh chute (12).

6. The apparatus as claimed in claim 4 or 5, wherein the speed measuring means (18) comprises a speed-measuring wheel (20) ahving a ribbed surface (22) on which the material impinges to rotate the wheel, the wheel (20) being arranged at an outlet end of the weigh chute (12) and the speed measuring means (18) further including a monitoring means (24, 26) for monitoring the speed of rotation of the wheel, the monitoring means (24, 26) generating the second signal.

7. The apparatus as claimed in claim 4, 5 or 6, wherein the feed means (28) and the weigh chute (12) are made of polished stainless steel.

8. The apparatus as claimed in claim 6 or 7, wherein the speed-measuring wheel (20) is made of light-weight material and is mounted on low-friction bearings.

9. The apparatus as claimed in any one of claims 4 to 8, wherein the processing means (38) includes an amplifier (40), a multiplier (42), and a scaling and pulse conversion module (44).

10. The apparatus as claimed in any one of claims 4 to 9, wherein the outputs of the processing means (38) are connected to a mass flow rate meter (46) and to a display (48) for totalisation of material weighed.

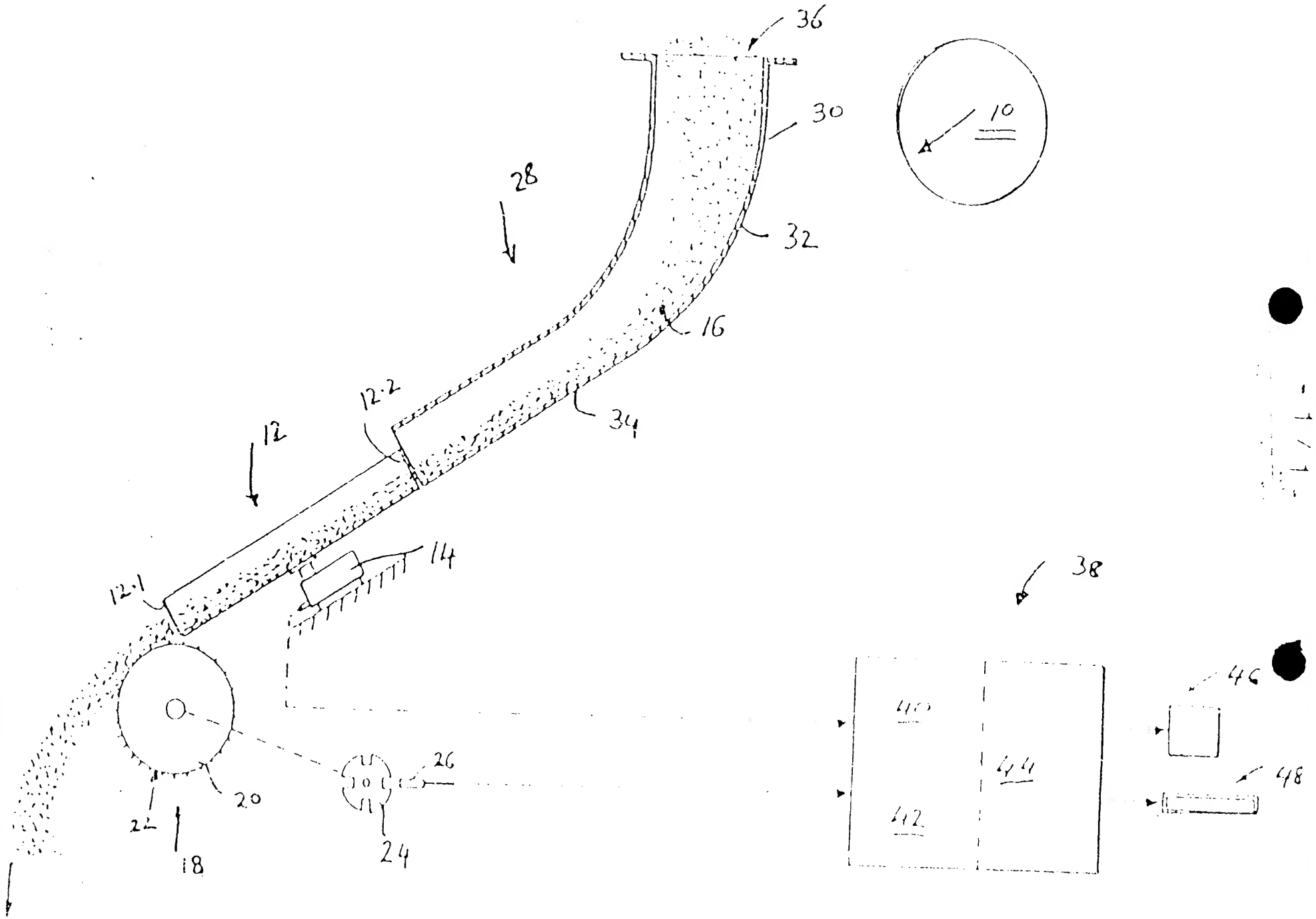
STATEMENT UNDER ARTICLE 19

Amended claims 1 and 4 have been drafted to better distinguish the present invention over a combination of DE-A-29 50 925 and US-A-1 883 017 cited in the International Search Report.

Amended claims 2 and 3 are as well considered to be distinguish over the combination of the two references mentioned above involving an inventive step.

Amended claims 5 and 6 correspond to claims 7 and 8 as filed and are as well distinguished over a combination of the above two references.

Amended claims 7 to 10 have been drafted to be directed on features not shown in any of the above two references.


36
30
28
32
16
12.2
34
12
14
12.1
38
46
40
44
48
42
26
20
22
18
24

International Application No PCT EP 89 00493

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: G 01 F 1/30, G 01 F 1/76

II. FIELDS SEARCHED

Minimum Documentation Searched *

Classification System	Classification Symbols
IPC[4]	G 01 F, G 01 G

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched *

III. DOCUMENTS CONSIDERED TO BE RELEVANT *

Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages **	Relevant to Claim No **
X	DE, A, 2950925 (ZAKLADY MECHANIKI PRECYZYJNEJ I AUTOMATYKI) 20 November 1980, see the whole document	1,4,5,8
Y	--	2,6,7
Y	US, A, 1883017 (R.J. SHOLTZ) 18 October 1932, see figures	2,6,7
	--	
A	DE, A, 1802213 (CARL SCHENCK MASCHINEN-FABRIK) 27 May 1970, see figure; page 2, line 23 - page 3, line 3	2,5-7
	--	
A	US, A, 4238956 (SNIEZEK et al.) 16 December 1980, see the whole document	1,4
	----	

* Special categories of cited documents: **

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20th July 1989	14.09.89
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	TK WILLIS

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. [illegible]

SA [illegible]

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on [illegible]
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-A- 2950925	20-11-80	None		
US-A- 1883017		None		
DE-A- 1902213	27-05-70	CH-A-	490670	15-05-70
		FR-A-	1597327	22-06-70
US-A- 4238956	16-12-80	AU-B-	521200	18-03-82
		AU-A-	4647679	25-09-80